

YUKON RIVER ANADROMOUS FISH INVESTIGATIONS  
TECHNICAL REPORT FOR PERIOD  
July 1, 1979 to June 30, 1980

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## Yukon River Salmon Studies

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## ABSTRACT

The 1979 Yukon area commercial harvest of 1,312,200 salmon was the second largest since accurate records have been kept. Composition of the 1979 catch was 803,500 summer chum, 362,500 fall chum, 129,100 king, and 17,100 coho. The subsistence harvest of 470,300 salmon was above the previous 5-year average of 312,474 fish.

High and turbid water conditions in 1979 made visual enumeration of the Anvik River salmon escapement difficult. The Anvik River king salmon escapement was estimated at 1,484 fish by tower count and aerial survey. The chum salmon escapement was estimated at 280,537 chum by sonar count and aerial survey.

The Tanana River fall chum salmon run was estimated at 796,963 fish based on the recovery of tagged fish, with an exploitation rate of 0.14. It appears that upper Tanana stocks migrate mostly along the north bank of the lower Tanana River, while Kantishna-Toklat stocks migrate later and mostly along the south bank. Further study is required to refine separation of these stocks.

## INTRODUCTION

The objectives of the Yukon River (Figures 1-4) salmon research program are to:

- (1) Determine the magnitude of commercial and subsistence harvests and the effect on stocks of king and chum salmon.
- (2) Develop estimates or indices of the magnitude and quality of king and chum salmon runs and escapements.
- (3) Monitor long term trends in the salmon stocks.
- (4) Evaluate management procedures necessary to maintain salmon stocks at the level of optimum sustained yield.

This report summarizes data collected during the 1979 field season. The major projects discussed are the Anvik River escapement study and the Tanana River fall chum tagging study. Other studies which contribute to the objectives of Yukon River salmon research include commercial and subsistence data analysis, lower Yukon River test fishing, and aerial escapement surveys. The results of these studies will be briefly discussed, but the reader is directed to Geiger and Andersen (1980) and Crawford (1979) for a more detailed presentation.

## SUPPORTING STUDIES

### Catch Data Analysis

Yukon River commercial fishery catch statistics (including date, location, and numbers of fish) are recorded on fish tickets when the fish are purchased from the fishermen. The tickets are collected from the processors by Alaska Department of Fish and Game personnel after each fishing period. From these records total catch, catch per unit effort, and total effort are compiled.

At the conclusion of the season, Department personnel conduct a subsistence survey of the entire river by boat and aircraft. Fishermen in each village are interviewed to obtain an estimate of the number of each species of salmon taken and related effort data. Catch calendars are mailed to the fishermen prior to the season to facilitate record keeping. The few fishermen not interviewed are sent questionnaires.

The 1979 Yukon area (Alaska portion of the drainage) commercial harvest of 1,312,200 salmon was the second largest since accurate records have been kept. Composition of the 1979 catch was 803,500 summer chum, 362,500 fall chum, 129,100 king, and 17,100 coho. The Yukon area subsistence harvest of 470,300 salmon was above the previous 5-year average of 312,474 fish. Composition of the 1979 subsistence catch was 31,000 king, and 439,300 other salmon, mostly chum, but including pink and coho.



Figure 1. Map of the Yukon River.

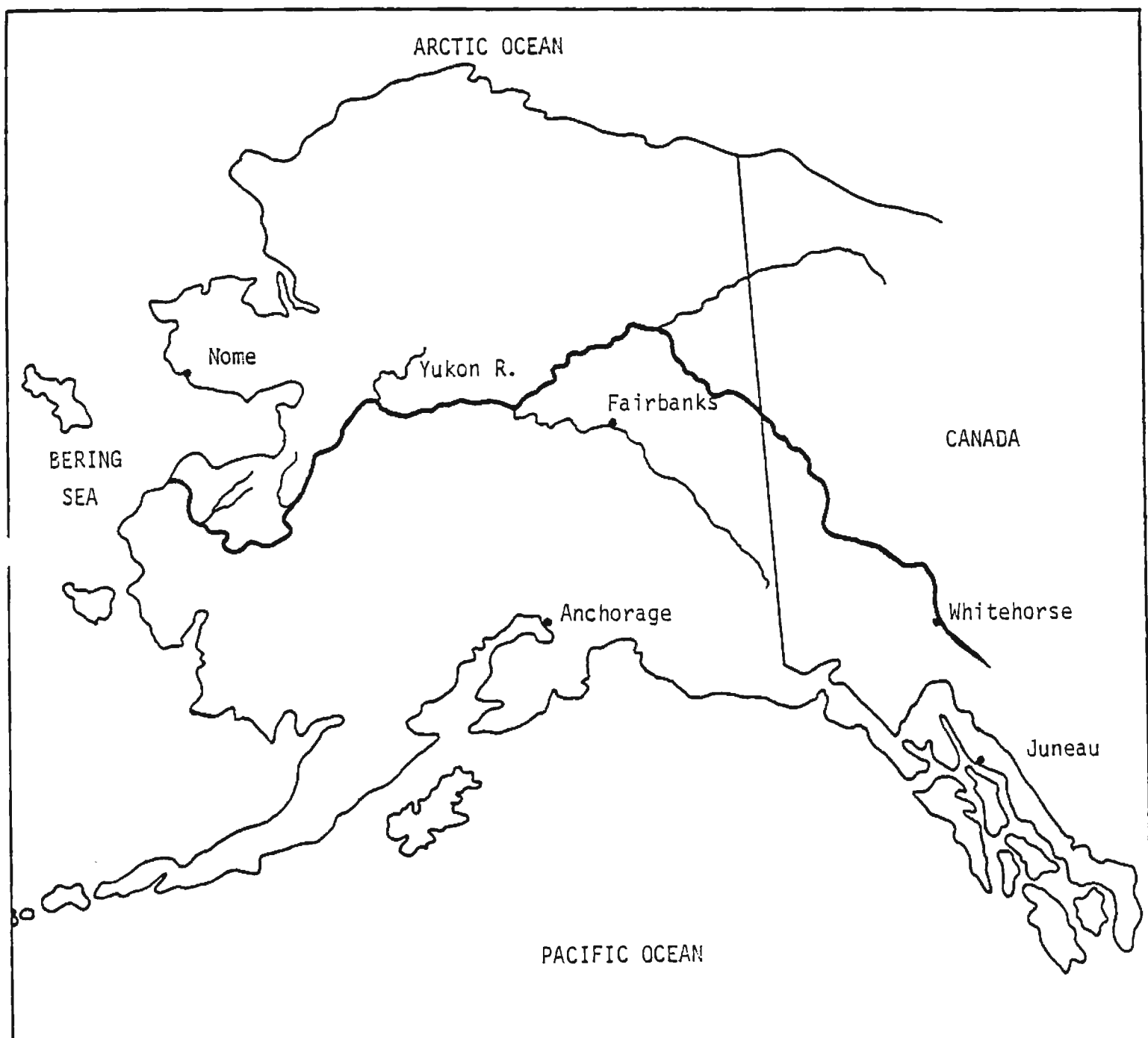


Figure 2. Map of the Lower Yukon River.

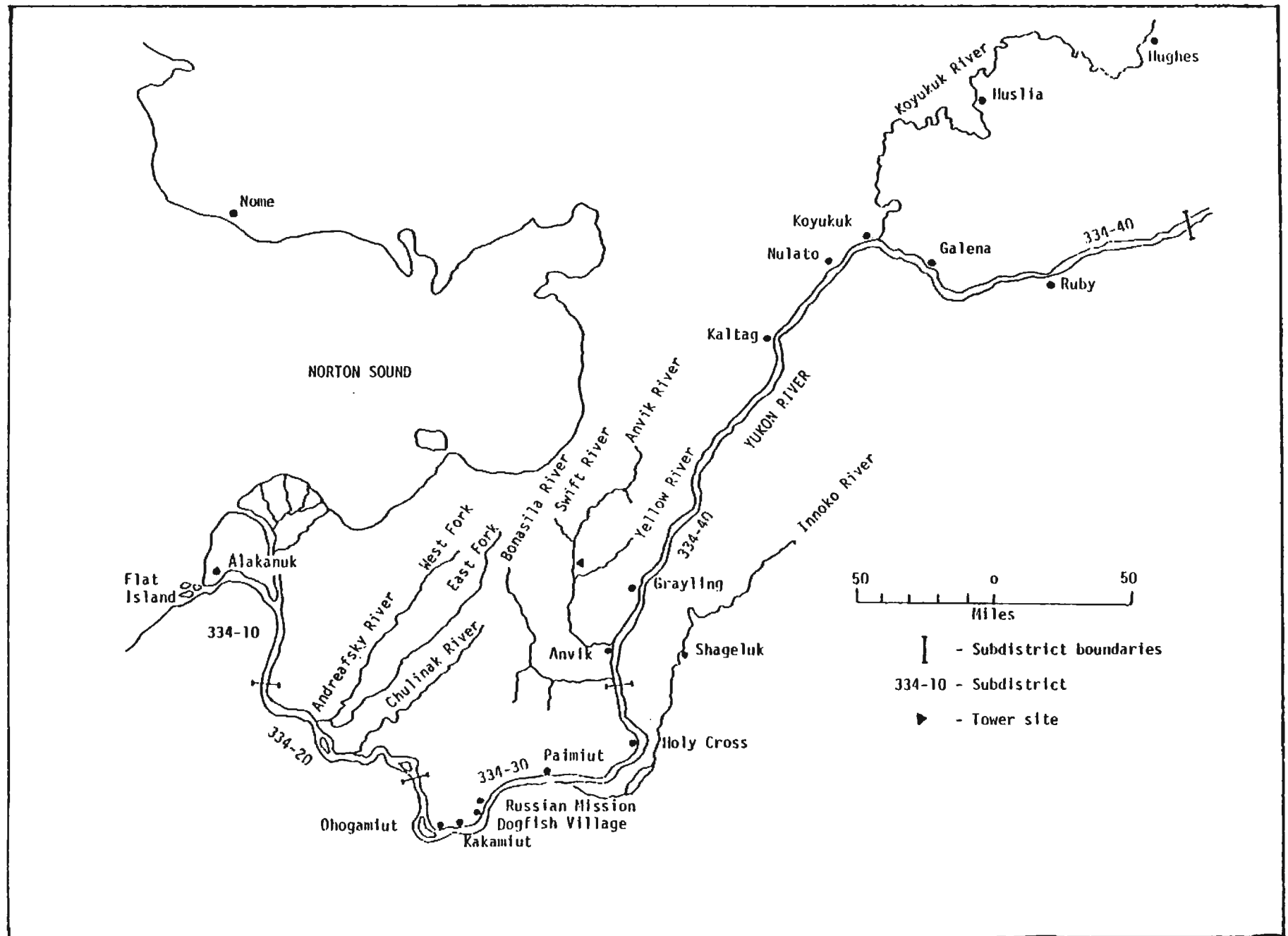


Figure 3. Map of the Middle Yukon River.

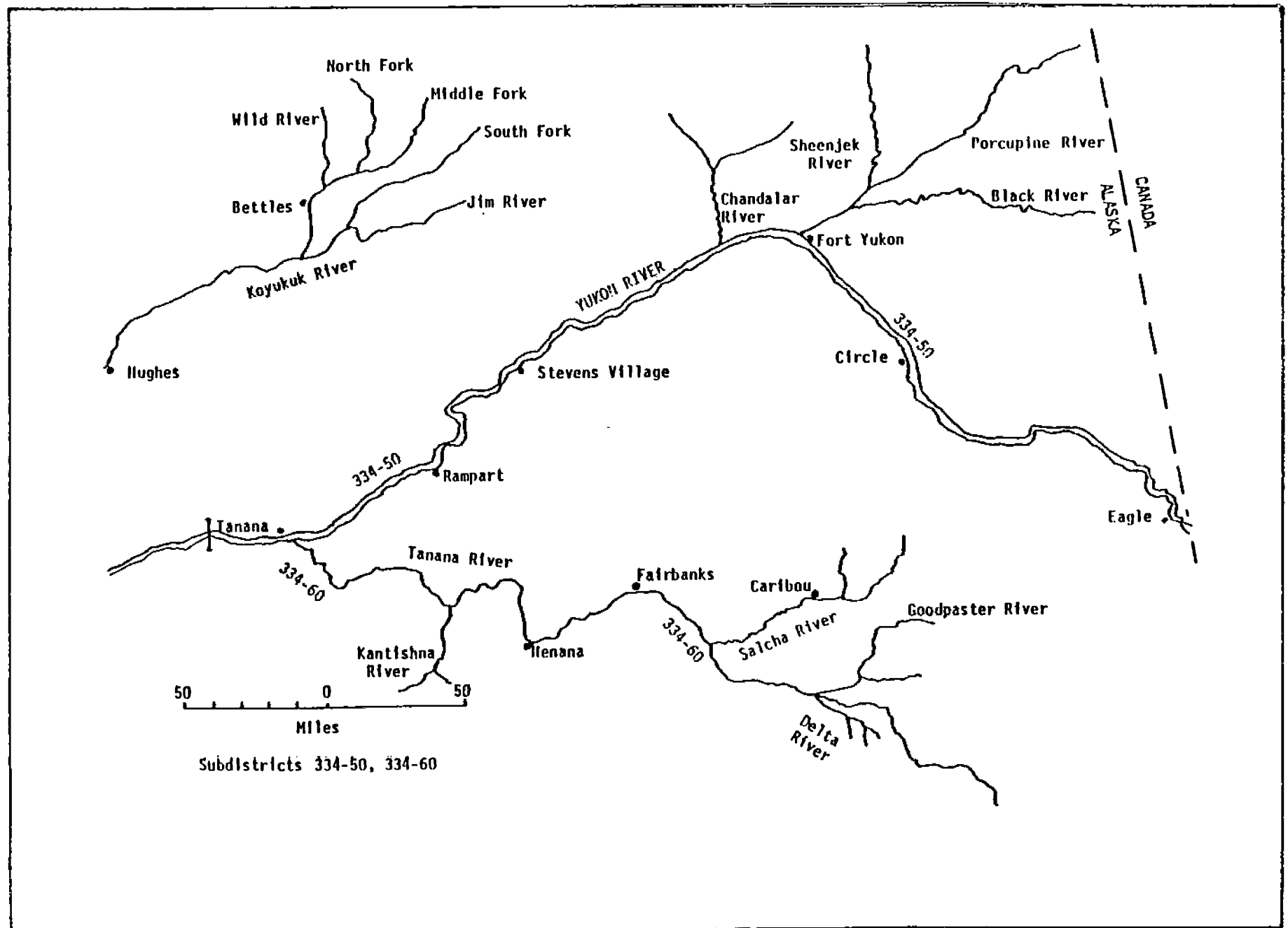
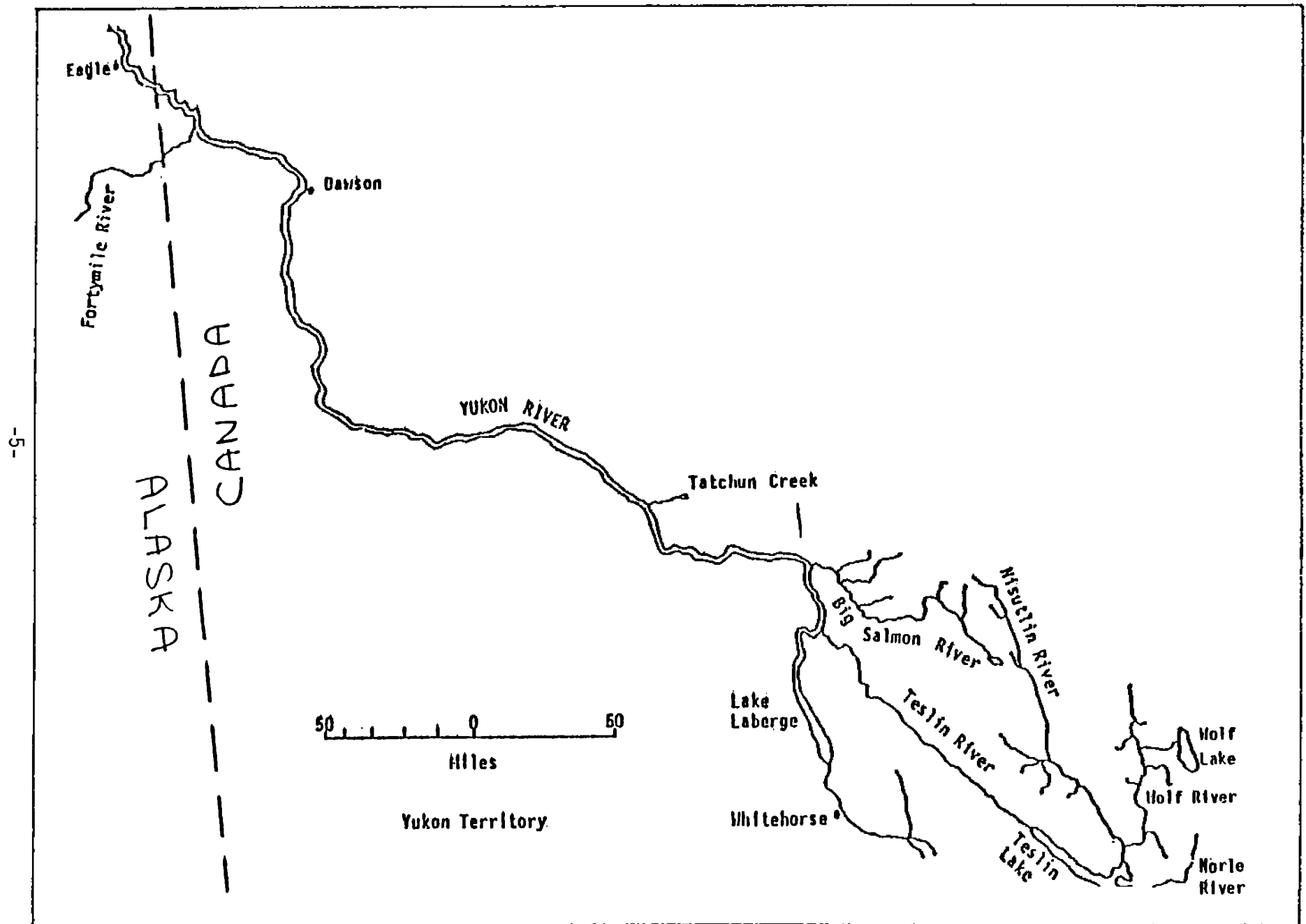


Figure 4. Map of the Upper Yukon River.



### Lower Yukon River Test Fishing

Several changes were made in the lower Yukon River test fishing program in 1979. In order to obtain more valid catch data, the Flat Island site (Figure 5), operated from 1963-1978, was terminated and the project was moved upriver 24 mi to the Big Eddy area (Figure 5). An additional site was established in the Middle Mouth of the Yukon River. Two 8½ in mesh and one 5½ in mesh gillnets were fished at each site. The fall chum and coho run was monitored at the Big Eddy site with two 6 in mesh gillnets.

Peak king salmon catches occurred at the Big Eddy site on 7, 11, and 28 June. Peak summer chum salmon catches occurred on 11 June, and 5 and 7 July. Although timing was similar, magnitude of the catches was greater for each species at the Middle Mouth site.

Peak fall chum salmon catches occurred on 4, 5, and 6 August, while peak coho salmon catches occurred on 5, 13, and 17 August. Overall fall chum test fishing catches for 1979 were below those of the two previous years, and it appeared that the run would be weaker than expected. However, following the conclusion of the project on 26 August, large commercial catches of fall chums indicated a strong run. The discrepancy is attributed to a late run of fall chums through the Big Eddy site after termination of the test fishing project and an undocumented run of fall chums through the Middle Mouth.

### Aerial Surveys

Salmon escapements in the Yukon River drainage are primarily assessed by aerial survey due to the immense size of the area and the great distances between salmon spawning streams. Index streams have been chosen as indicators of overall Yukon River basin escapement. During the peak of spawning, and when water and light conditions are optimal, these streams are surveyed from single engine aircraft. While not precise, aerial surveys are an important tool for assessing in-season management strategy.

King salmon escapements in most index spawning areas in 1979 ranged from average to above average (Table 1). Record escapements were documented in the Nulato, Gisasa, Salcha, and Nisutlin Rivers. The Whitehorse Dam fishway count of 1,184 kings was second only to the 1962 escapement.

Summer chum salmon escapements in 1979 were below average to average throughout the drainage (Table 2). Combined total escapement in the Anvik and Andreafsky River system, the major summer chum salmon producers, was estimated at 390,000 fish. Throughout the Yukon River drainage a total of 456,000 summer chum were documented in selected escapement surveys.

The Department has conducted intensive surveys of fall chum salmon spawners in the upper Yukon River drainage for the past 8 years (Table 3). Escapements of fall chums in 1979 were considered average to above average. A record escapement of 172,000 fall chum was observed in the Toklat River (Tanana River tributary). Record escapements were also observed in the upper Tanana River drainage. Escapements in the Porcupine River (chiefly Fishing Branch and Sheenjek) system were above average, but below the magnitude of the 1975 brood year escapement.

Figure 5. Lower Yukon River test fishing sites, 1979.

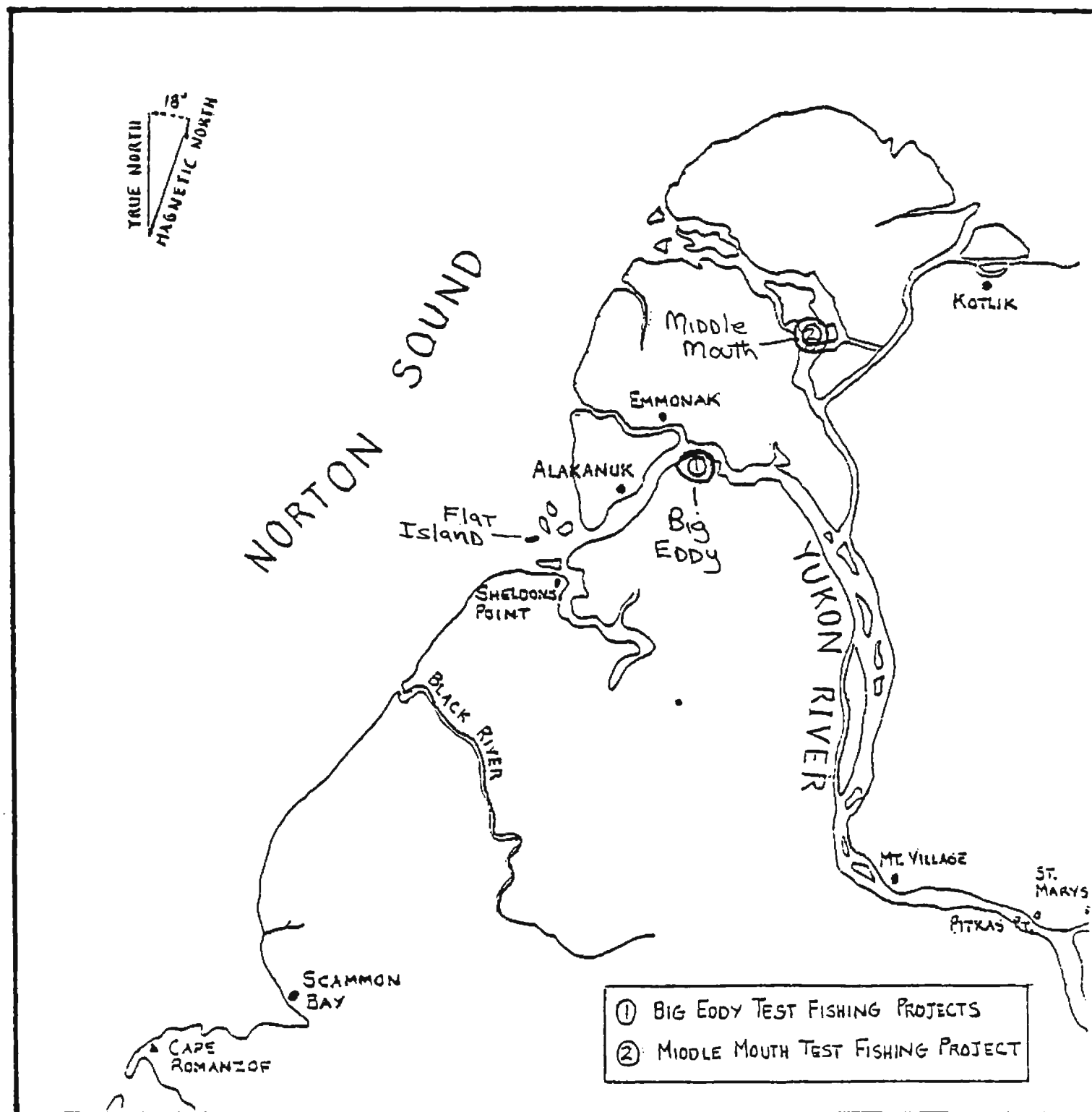


Table 1. King salmon escapement estimates, Yukon River drainage, 1960-1979<sup>1</sup>.

Year	Andreafsky River (East Fork)	Andreafsky River (West Fork)	Nulato River	Anvik River	Chena River	Salcha River	Nisutlin River Sidney-100 Mi. Creek	Whitehorse Dam Fishway
1960	1,020	1,220	756	1,950	132	1,660		660
1961	1,003		543	1,226		2,878		1,068
1962	675	762				937		1,500
1963								484
1964	867	705				450		587
1965		355		650		408		903
1966	361	303		638		800		563
1967		276		336				533
1968	380	383		297		735	407	407
1969	231	274		296		461	105	334
1970	665	574		368		1,882	615	625
1971	1,904	1,284			193 <sup>5</sup>	159	640	856
1972	798	582		1,172 <sup>2</sup>	138 <sup>5</sup>	1,193	317	392
1973	825	788		613 <sup>2</sup>	21	249	36	228
1974		285	78	506 <sup>4</sup>	1,035 <sup>5</sup>	1,857	48	273
1975	993	421	204	720 <sup>3</sup>	316 <sup>5</sup>	1,055	249	313
1976	818	643	648	1,155 <sup>3</sup>	531	1,691	102	120
1977	2,008	1,499	487	1,354 <sup>3</sup>	563	1,202	77	277
1978	2,487	1,062	920	1,281 <sup>3</sup>	1,726	3,499	375	725
1979	1,180	1,134	1,507	1,484	1,159	4,789	620	1,184

<sup>1</sup> With the exception of the Whitehorse fishway counts, the data was obtained from surveys (mostly aerial) of the main stem of each river listed.

<sup>2</sup> Combination tower counts and aerial survey.

<sup>3</sup> Combination boat and aerial survey.

<sup>4</sup> Tower count.

<sup>5</sup> Boat survey.

Table 2. The ten most important summer chum salmon streams in the Yukon River drainage, 1975 - 1979, ranked by observed escapement.<sup>1/</sup>

1979			1978			1977			1976			1975		
Ranking	Stream	Escapement	Ranking	Stream	Escapement	Ranking	Stream	Escapement	Ranking	Stream	Escapement	Ranking	Stream	Escapement
1. Anvik <sup>2/</sup>		281	1. Anvik <sup>3/</sup>		251	1. Anvik <sup>3/</sup>		263	1. Anvik <sup>3/</sup>		406	1. Anvik <sup>3/</sup>		813
2. Andreafsky East		66	2. Andreafsky East		127	2. Andreafsky East		113	2. Andreafsky West		118	2. Andreafsky West		236
3. Andreafsky West		43	3. Andreafsky West		57	3. Andreafsky West		63	3. Andreafsky East		105	3. Andreafsky East		223
4. Nulato North		33	4. Nulato North		39	4. Nulato North		58	4. Rodo		38	4. Nulato North		87
5. Gisasa		11	5. Rodo		18	5. Rodo		16	5. Chulinak		34	5. Gisasa		57
6. Caribou Creek		9	6. Nulato South		15	6. Thompson		15	6. Nulato North		27	6. Nulato South		51
7. Clear Creek		5	7. Gisasa		9	7. Nulato South		11	7. Gisasa		21	7. Rodo		25
8. Salcha		3	8. Melozitna		6	8. Gisasa		2	8. Thompson Creek		17	8. Caribou Creek		15
9. Melozitna		3	9. Salcha		5	9. Clear		2	9. Nulato South		12	9. S. Fork Koyukuk		15
10. Nulato South		2	10. S. Fork Koyukuk		3	10. Mt. Village		2	10. Caribou Creek		11	10. Melozitna		9
Total		456			530			545			789			1,531

<sup>1/</sup> In thousands of fish. Based on aerial survey estimates.

<sup>2/</sup> Includes sonar estimate.

<sup>3/</sup> Includes tower count estimate.



Table 3. The most important fall chum salmon spawning areas in the Yukon River drainage, 1975-1979, ranked by observed escapement. <sup>1/</sup>

Ranking	1979 Stream	Escapement	Ranking	1978 Stream	Escapement	Ranking	1977 Stream	Escapement	Ranking	1976 Stream	Escapement	Ranking	1975 Stream	Escapement
1.	Toklat	172	1.	Toklat	35	1.	Fishing Branch	33	1.	Toklat	37	1.	Fishing Branch	353
2.	Fishing Branch	44	2.	Fishing Branch	15	2.	Toklat	25	2.	Fishing Branch	13	2.	Toklat	78
3.	Sheenjek	41	3.	Sheenjek	15	3.	Sheenjek	21	3.	Sheenjek	12	3.	Sheenjek	78
4.	S. Bank Tanana	20	4.	Delta	10	4.	Delta	18	4.	Delta	6	4.	Yukon River (Mainstem, Canada)	7
5.	Delta	8	5.	S. Bank Tanana	6	5.	Bluff Cabin Slough	6	5.	Tanana	5	5.	Chandalar	6
6.	Bluff Cabin Slough	7	6.	Bluff Cabin Slough	5	6.	Chandalar	4	6.	Bluff Cabin Slough	3	6.	Bluff Cabin Slough	5
7.	Kluane	4	7.	Benchmark 735	2	7.	Upper Tanana	4	7.	Delta Clearwater Slough	2	7.	Delta	4
8.	Benchmark 735	3				8.	Delta Clearwater	2				8.	Bear Paw	2
						9.	Benchmark 735	1				9.	Black	2
						10.	Kluane	1						
TOTAL		299			88			115			78			535

<sup>1/</sup> In thousands of fish. Based on aerial survey estimates.

## ANVIK RIVER SALMON ESCAPEMENT STUDY

### Introduction

The Anvik River (Figure 6) is the single most important chum salmon producer in the Yukon River drainage. It is also one of only four Alaskan, Yukon River tributaries with regularly documented king salmon escapements in excess of 1,000 fish. A description of the Anvik River, including an abridged listing of its flora and fish species is provided by Mauney (1977). The magnitude and quality of the Anvik River chum and king salmon escapements was monitored in 1979 for the eighth consecutive year.

### Methods and Materials

Salmon escapement was enumerated by two methods: visual counting from a tower; and sonar counting using a side-scanning sonar counter developed by the Hydrodynamics Division of the Bendix Corporation (Menin 1976).

The counting tower was located near Robinhood Creek, approximately river mile 70 on the Anvik River. The tower was erected aboard a log raft and anchored in midstream on 1 July. High water levels prohibited installation of a weir. Background panels were installed on the river bottom to provide color contrast with migrating salmon. The river was divided into three sectors: east bank, midstream, and west bank.

The sonar counter was located near Theodore Creek, approximately river mile 40 on the Anvik River. The west bank substratum was installed on 22 June, and the east bank substratum on 27 June. The equipment is designed to transmit a sonic beam along the substratum, and fish passing through the beam are counted. Resultant counts are totaled electronically for each 5 ft section of the 60 ft substratum. The sonar counter does not distinguish chum from king salmon, and does not account for the downstream movement of some of the fish. Escapement through the unsonified midstream is not counted. A 4 ft section of scaffolding from a counting tower was installed on a skiff and anchored in midstream during clear water conditions to visually calibrate sonar counts.

King and chum salmon carcasses were sampled from spawning grounds. Sampled fish were identified by sex, measured from mideye to fork of tail (mm), and a scale sample taken for age determination.

### Results and Discussion

Turbid water conditions made visual enumeration from the upriver Robinhood Creek counting tower difficult, but the degree of inaccuracy was unknown. Expansion of the actual tower counts for missing sector counts yielded an escapement estimate of 37,150 chum salmon (Table 4). An aerial survey of the Anvik River above the tower site was conducted on 16 July, and 84,580 chum salmon were counted. This suggests that the tower count was, at best, 40% accurate. Actual king salmon tower counts totaled 1,247 fish, and no expansion factors were developed for missing sector counts (Table 5). Addition of 237 king salmon counted by aerial survey below the tower site

Table 4. Chum salmon tower counts, Anvik River, 1979.

Date	West Bank		Midstream		East Bank		Actual Total		Expanded		
	N	% <sup>2/</sup>	N	% <sup>2/</sup>	N	% <sup>2/</sup>	N	%	Total	Daily %	Cum %
7/1	1,433	87	220	13	(3,181) <sup>3/</sup>	(66)	1,653	100	(4,834)	13	13
7/2	564	82	123	18	(1,334)	(66)	687	100	(2,021)	5	18
7/3	251	71	100	29	(681)	(66)	351	100	(1,032)	3	21
7/4	2	7	29	93	(602)	(66)	31	100	(633)	2	23
7/5	72	61	45	39	(227)	(66)	117	100	(344)	1	24
7/6	36	29	88	71	(241)	(66)	124	100	(365)	1	25
7/7	36	29	88	71	(241)	(66)	124	100	(365)	1	26
7/8	-11	7	-151	93	(-314)	(66)	-162	100	(-476)	-1	25
7/9	11	-	132	3	3,497	97	3,637	100	3,637	10	35
7/10	151	6	208	8	2,147	86	2,506	100	2,506	7	42
7/11	485	19	316	12	1,769	69	2,570	100	2,570	7	49
7/12	566	14	553	13	2,974	73	4,093	100	4,093	11	60
7/13	710	20	984	29	1,750	51	3,444	100	3,444	9	69
7/14	631	25	758	30	1,112	45	2,501	100	2,501	7	76
7/15	178	11	827	51	613	38	1,618	100	1,618	4	80
7/16	178	20	721	80	(1,745)	(66)	899	100	(2,644)	7	87
7/17	119	29	285	71	(784)	(66)	404	100	(1,188)	3	90
7/18	94	20	270	58	103	22	467	100	467	1	91
7/19	154	25	198	32	264	43	616	100	616	2	93
7/20	(318) <sup>4/</sup>	(21)	806	67	391	33	1,197	100	(1,515)	4	97
7/21	(259)	(21)	769	79	205	21	974	100	(1,233)	3	100
Actual Totals	5,660		7,369		14,822		27,851				
Totals 7/9-15 & 7/18-19	2,980		4,246		14,226		21,452				
Expanded Totals	6,237		7,369		23,544				37,150		

1/ Sector counts were based on expanded daily counts. The actual daily count totaled 6,573 for the season.

2/ Percent of total for sectors counted.

3/ East bank counts were estimated to be 66% of expanded daily count based on sum of actual counts on 7/9-7/15 and 7/18-7/19 for west, midstream and east bank sectors.

4/ West bank counts were estimated to be 21% of expanded daily count based on sum of actual counts on 7/9-7/15 and 7/18-7/19 for west, midstream and east bank sectors.

Table 5. King salmon tower counts, Anvik River, 1979.

Date	West Bank		Midstream		East Bank		Actual Total	
	N	%	N	%	N	%	N	%
7/1	0	0	0	0	1/	-	0	0
7/2	3	100	0	0	-	0	3	0
7/3	0	0	17	100	-	0	17	1
7/4	6	200	-3	-100	-	-	3	0
7/5	0	0	0	0	-	-	0	0
7/6	-	-	-	-	-	-	-	0
7/7	-	-	-	-	-	-	-	0
7/8	0	-	-2	100	-	-	-2	0
7/9	37	38	15	16	45	46	97	8
7/10	6	17	17	47	13	36	36	3
7/11	27	23	62	54	26	23	115	9
7/12	49	27	103	58	26	15	178	14
7/13	57	35	105	65	0	0	162	13
7/14	97	50	77	40	20	10	194	16
7/15	56	33	112	67	0	0	168	14
7/16	47	39	72	61	-	-	119	10
7/17	21	32	44	68	-	-	65	5
7/18	-19	-65	-10	-35	-	-	-29	-2
7/19	36	44	29	36	16	20	81	6
7/20	-	-	40	100	0	0	40	3
Total	423	34	678	54	146	12	1,247	100

1/ (-) No observations made.

(Appendix 1) yields a minimum escapement estimate of 1,484 king salmon. This is greater than the previous 5-year average escapement of 1,003 king salmon, and second only to the 1960 escapement of 1,950 king salmon.

Expansion of the sonar counts for missing sectors and dates, as well as adjustment for unsonified river area and the downstream movement of some fish, yielded an escapement estimate of 277,712 chum salmon (Table 6 - see footnote 5). Since the sonar counter does not distinguish between chum and king salmon, and the chum salmon escapement vastly outnumbers the king salmon escapement, all sonar counts have been attributed to chum salmon. Attempts to visually calibrate the sonar counter, and further document midstream escapement and downstream movement were unsuccessful as a result of turbid water conditions. Addition of 2,825 chums counted by aerial survey below the sonar site yields a total escapement estimate of 280,537 chum salmon. This is below the previous 5-year average of 393,416 chum salmon, although the latter is based on upriver tower counts and aerial survey and may not be directly comparable.

Chum salmon movement into the Anvik River was early in 1979 and exhibited peaks on 10 and 12 July (Figure 7). Migration timing as determined by sonar counts in 1979 cannot be directly compared to tower counts of previous years, since the sonar site is located some 30 mi below the tower site.

The age composition of 579 chum salmon carcasses sampled was 347 (59.9%) age 4<sub>1</sub> and 214 (37%) age 5<sub>1</sub> (Table 7)<sup>1</sup>. Since 1972 the age composition of Anvik River chums has averaged 61.7% age 4<sub>1</sub>. The age composition of 46 king salmon carcasses sampled was 17 (37.0%) age 4<sub>2</sub>, 14 (30.4%) age 5<sub>2</sub>, and 12 (26.1%) age 6<sub>2</sub> (Table 8). Only 9 (20%) of the king salmon sampled were females, while 37 (80%) were males. The sex ratio of the sample may not be representative of the escapement due to selective predation for female king salmon by bears, small sample size, and the fact that samples were collected over a period of several days rather than throughout the escapement.

### Conclusions

High and turbid water conditions in 1979 made visual enumeration of the Anvik River salmon escapement from a counting tower difficult. The king salmon escapement was estimated at 1,484 fish by tower count and aerial survey. The chum salmon escapement was estimated at 280,537 by sonar count and aerial survey. It is recommended that future salmon escapement studies on the Anvik River be limited to sonar enumeration and aerial survey.

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<sup>1</sup> Gilbert-Rich Formula - Total years of life at maturity (large type) - year of life at outmigration from freshwater (subscript).

Table 6. Anvik River chum salmon sonar counts by river bank and date, 1979.

Date	Whole Hours	West Bank Counts		East Bank Counts		West and East Banks	Total		
		Actual	Expanded	Actual	Expanded		Entire River <u>3/</u>	Daily %	Cum %
6/23	4	125	668 <sup>1/</sup>	-	(145) <sup>2/</sup>	813	903	-	-
6/24	22	1,276	1,381	-	(299)	1,680	1,866	1	1
6/25	20	1,170	1,274	-	(275)	1,549	1,721	1	2
6/26	18	1,171	1,584	-	(342)	1,926	2,140	1	3
6/27	16	3,032	4,636	-	(1,002)	5,638	6,265	2	5
6/28	10	2,821	7,100	913	(1,369) <sup>1/</sup>	8,460	9,410	3	8
6/29	6	2,560	10,086	1,146	1,146	11,232	12,480	4	12
6/30	9	6,076	17,611	600	600	18,211	20,234	7	19
7/1	5	3,082	14,402	291	291	14,693	16,325	5	24
7/2	14	6,484	10,825	678	678	11,503	12,781	4	28
7/3	12	6,029	10,982	3,145	3,145	14,127	16,697	5	33
7/4	7	2,978	8,533	3,328	3,328	13,178	14,642	5	38
7/5	2	803	8,452	3,981	3,981	12,433	13,814	4	42
7/6	6	2,202	9,658	2,009	2,009	11,667	12,963	4	46
7/7	23	6,576	6,786	1,932	1,932	8,718	9,687	3	49
7/8	16	5,297	8,264	3,315	3,315	11,579	12,865	4	53
7/9	7	4,482	(8,574) <sup>4/</sup>	2,848	2,848	10,454	11,616	4	57
7/10	7	6,961	(16,890)	6,740	6,740	21,370	23,744	8	65
7/11	8	5,819	(12,844)	5,948	5,948	16,770	18,633	6	71
7/12	11	8,480	(11,016)	11,102	11,102	22,118	24,575	8	79
7/13	14	11,034	(11,272)	-	(2,437) <sup>2/</sup>	13,709	15,232	5	84
7/14	20	10,609	(8,316)	-	(1,798)	10,114	11,238	4	88
7/15	19	9,023	(7,081)	-	(1,531)	8,612	9,569	3	91
7/16	16	6,562	(6,125)	-	(1,324)	7,449	8,277	3	94
7/17	17	4,484	(3,597)	-	(778)	4,375	4,861	2	96
7/18	22	3,088	(2,262)	-	(489)	2,751	3,057	1	97
7/19	20	2,955	(2,310)	-	(499)	2,809	3,122	1	98
7/20	21	2,970	(2,225)	-	(481)	2,706	3,006	1	99
7/21	5	852	(2,825)	-	(611)	3,436	3,818	1	100
7/22	1	70	(1,049)	-	(227)	1,276	1,418	-	-
7/23	8	522	(1,192)	-	(258)	1,450	1,610	-	-
Total	386	129,592	219,820	47,976	60,928	276,815	308,569 <sup>5/</sup>	100	

<sup>1/</sup> Counts expanded for missing hours based on the migration pattern during 1973, 1976 and 1977 (Mauney, 1980).

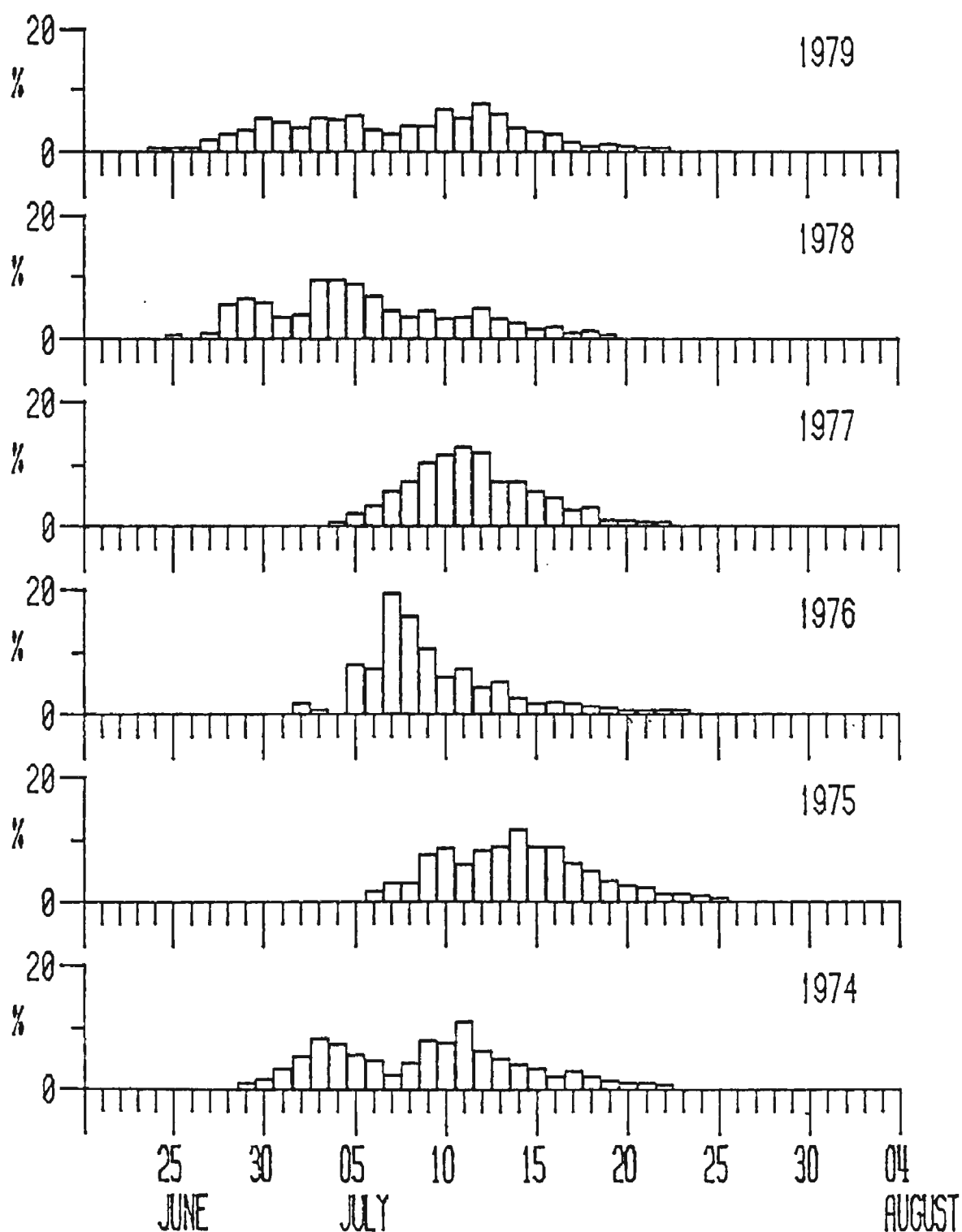
<sup>2/</sup> The percent passage along the east bank in 1978 was 18% of total river migration, while it was 14% in 1979 for hours with total counts available. Counts were expanded using an average 16% for passage along the east bank.

<sup>3/</sup> Undocumented midstream passage estimated to be 10% of total passage based on visual counts obtained in 1978 (Mauney, 1980).

<sup>4/</sup> Counts adjusted for spawner activity along the west bank substratum from 7/9 to 7/22. Actual counts estimated to be 66% of sonar counts based on visual count calibration.

<sup>5/</sup> The escapement estimate is 277,712 chum salmon. Total sonar count of 308,569 was adjusted downwards by 10.1% to account for the downstream movement of chum salmon documented during previous Anvik River counting tower projects.

Figure 7. Daily chum salmon migration pattern,  
Anvik River, 1974-1979.<sup>1/</sup>



<sup>1/</sup> Based on sonar counts in 1979, tower counts for all previous years.

Table 7. Age composition of Anvik River chum salmon, 1972-1979.

Age <sup>1</sup>	<u>1972</u>		<u>1973</u>		<u>1974</u>		<u>1975</u>		<u>1976</u>		<u>1977</u>		<u>1978</u>		<u>1979</u>		<u>All years</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
3 <sub>1</sub>	0	-	48	6	36	9	21	4.6	7	1.1	131	22	1	-	14	2.4	258	6.0
4 <sub>1</sub>	62	19	605	77	217	79	541	93.6	81	12.9	431	73	390	71	347	59.9	2674	61.7
5 <sub>1</sub>	253	79	128	16	46	12	22	4.8	537	85.8	22	4	161	29	214	37.0	1383	31.8
6 <sub>1</sub>	5	2	2	2	1	1	0	0.0	1	0.0	5	2	0	-	4	0.7	20	0.5
Total	320	100	783	100	302	100	584	100.0	626	100.0	589	100	552	100	579	100	4,335	100

<sup>1</sup> Gilbert-Rich Formula - Total years of life at maturity (large type) - year of life at outmigration from freshwater (subscript).



Table 8. Age and sex composition of Anvik River king salmon, 1979.

<u>Sex</u>	<u>AGE 4<sub>2</sub></u>		<u>AGE 5<sub>2</sub></u>		<u>AGE 6<sub>2</sub></u>		<u>AGE 7<sub>2</sub></u>		<u>Combined Age Class</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Male	17	37.0	14	30.4	6	13.0	0	0.0	37	80.4
Female	0	0.0	0	0.0	6	13.1	3	6.5	9	19.6
Total	17	37.0	14	30.4	12	26.1	3	6.5	46	100.0

## TANANA RIVER FALL CHUM SALMON TAGGING STUDY

### Introduction

State funds became available 1 July 1976 to conduct a tagging study of Yukon River fall chum salmon as part of a statewide salmon stock separation program. Results of studies conducted from 1976 through 1978 indicated that the majority of fall chums migrating along the north bank of the Yukon River in the Galena-Ruby area (Figure 8) were upper Yukon River stocks, while chums migrating along the south bank were primarily Tanana River stocks (Mauney 1980). The objective of the 1979 tagging study was to determine whether upper Tanana and Kantishna-Toklat stocks can be distinguished by run timing and/or bank orientation in the lower Tanana River. Recent surveys have shown that chum salmon escapement to the Toklat has substantially exceeded escapement to the upper Tanana drainage (Table 9). Regulations that will allow adequate harvest of Kantishna-Toklat stocks in the lower Tanana, while protecting upper Tanana River stocks may be needed in the future.

### Methods

Two fishwheels of the standard large Yukon River design were rented under contract from local fishermen and placed in the lower Tanana River. One wheel was located on the south bank of the Tanana, approximately 40 mi downstream from the village of Manley Hot Springs, while the other wheel was located on the north bank of the Tanana, approximately 8 mi below Manley Hot Springs (Figure 8). Captured chum salmon were identified by sex and maturity, measured from mideye to fork of tail (mm), and tagged with an individually numbered orange (south bank wheel) or yellow (north bank wheel) spaghetti tag. Scale samples were taken from a subsample of the catch throughout the run for age determination. Not all chums captured were tagged although the total catch was recorded for each wheel each day. The few coho salmon captured were tagged and measured as described above.

A two dollar reward was paid for each tag returned, and the tag recovery program was announced to local fishermen. The date, location, and method of recovery was reported with the tag returns. In addition, Department personnel conducted spawning ground surveys for tag recoveries on the Delta Clearwater River, Bluff Cabin Slough, Tanana River south bank, Delta River, and Toklat River.

### Results and Discussion

A total of 10,632 chum salmon was captured by the north bank fishwheel between 17 August and 3 October, while 4,786 chum salmon were captured by the south bank fishwheel between 15 August and 30 September (Appendix 2). Peak catches occurred on the north bank on 31 August, 9 and 18 September, and on the south bank on 30 August and 17 September (Figure 9). Of the total captured, 3,728 chums were tagged at the north bank wheel and 3,531 chums were tagged at the south bank wheel (Appendix 3).

Figure 8. Map of the fall chum salmon study area.

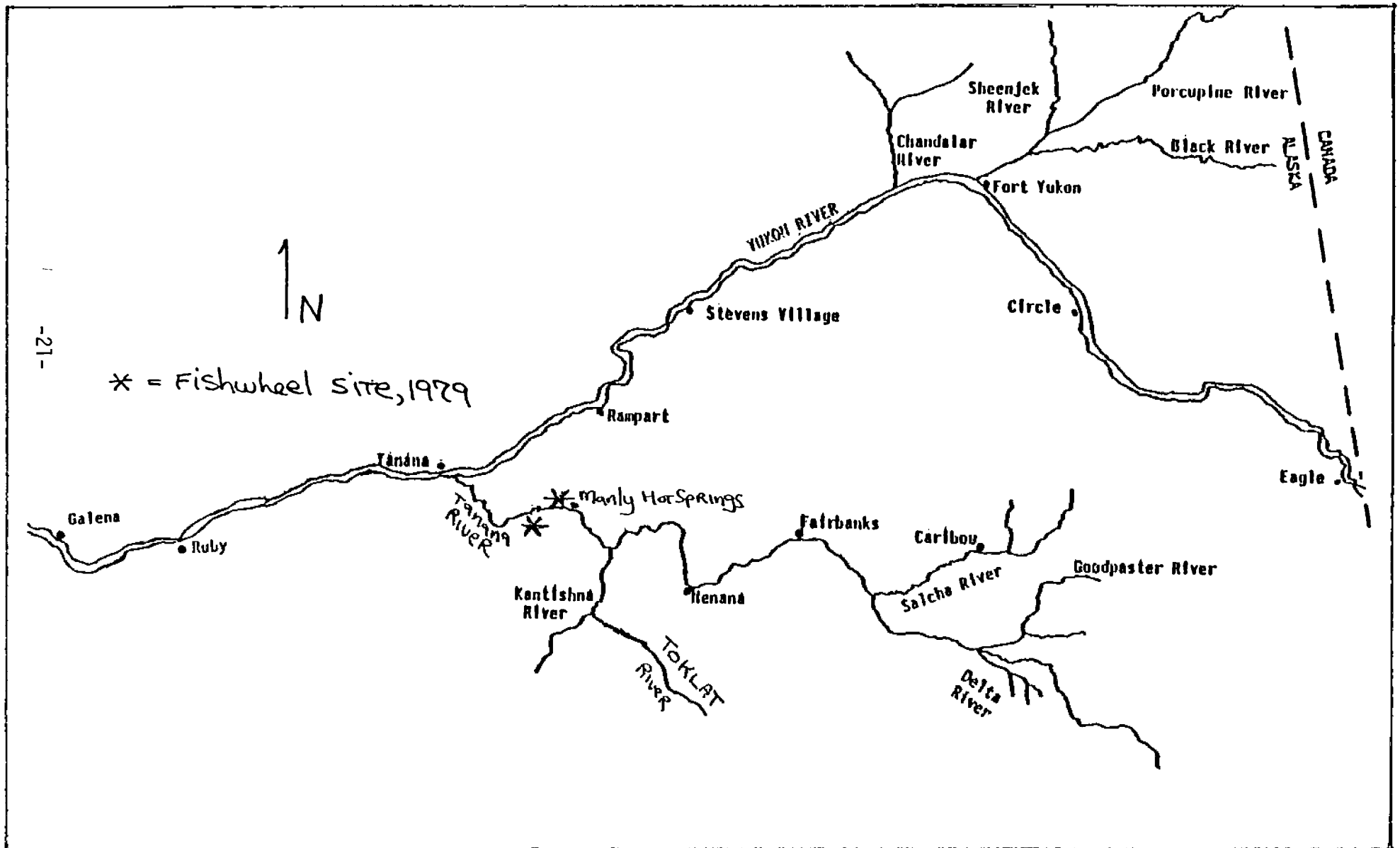


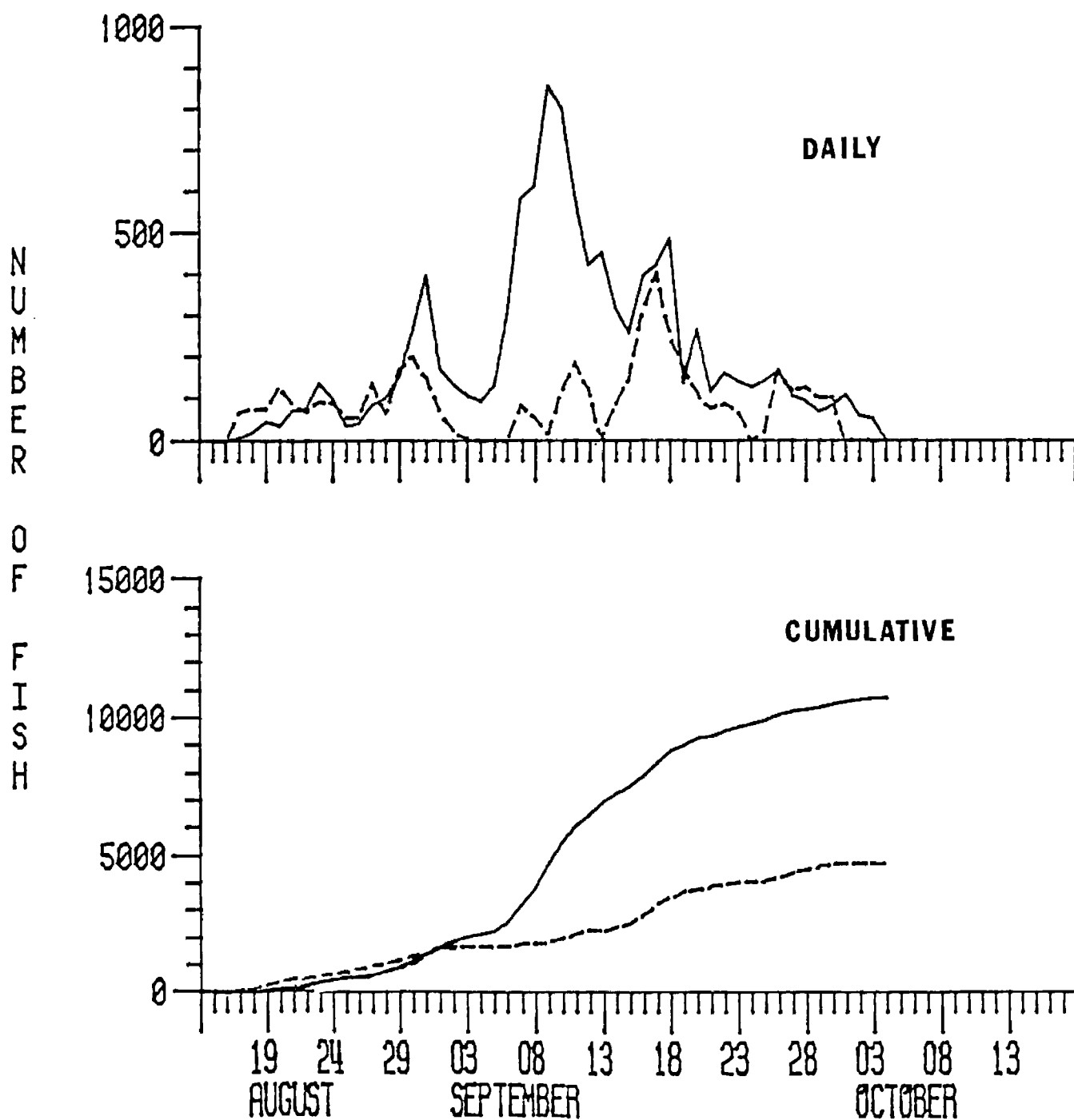
Table 9. Chum salmon escapement to the Tanana River drainage, 1975-1979. <sup>1/</sup>

	Upper Tanana Drainage					Toklat River
	<u>Delta River</u>	<u>Bluff Cabin Slough</u>	<u>Benchmark Slough</u>	<u>One Mile Slough</u>	<u>Tanana South Bank</u>	
1979	8.1	6.9	2.7	3.9	20.8	172.1 <sup>2/</sup>
1978	10.1	5.3	1.7	0.5	5.7	35.0 <sup>2/</sup>
1977	17.9	6.5	1.3	1.9	3.7	25.0 <sup>2/</sup>
1976	5.5	3.2	0.3	1.6	5.0	37.2 <sup>2/</sup>
1975	3.9	5.0	-	0.7	-	78.3

<sup>1/</sup> In thousands of fish. Estimated by aerial survey.

<sup>2/</sup> Aerial survey estimate adjusted by foot survey.

Figure 9. Tanana River fall chum salmon catch  
by the north bank (—) and south bank (----) fishwheels.



A total of 432 coho salmon was captured by the north bank fishwheel and 48 by the south bank fishwheel. Of the total captured, 225 were tagged and 37 (17%) were later recovered. Thirty-one of the tag recoveries were from the main Tanana River, while the other six recoveries came from scattered tributaries in the drainage. Too few coho salmon were tagged to allow for any meaningful conclusions concerning migration paths or timing. The majority of the fish were age 43 (Table 10).

A total of 1,309 chum salmon tags (18%) was recovered. The majority of the tagged fish were captured by fishwheel (Table 11). A large proportion of the tag recoveries was submitted by subsistence fishermen (Table 12). The reported subsistence harvest of 51,766 chum salmon produced 672 tag returns for a tagged:untagged chum salmon ratio of 1:77. The commercial harvest is accurately inventoried through the collection of fish tickets from the fish processors. The reported commercial harvest of 34,300 chum salmon produced 251 tag returns for a tagged:untagged chum ratio of 1:137. Since the tagged fish had an equal probability of capture by subsistence and commercial fishermen, the tag returns should have been proportional to the total catch by each fishery. It appeared that a substantial number of subsistence caught fall chums from the Tanana River went unreported. Applying the tagged:untagged ratio from the commercial fishery to the tag returns from the subsistence fishery yields an estimated subsistence harvest of 92,000 chum salmon compared to the 51,766 reported subsistence harvest.

A simple Petersen population estimate (Ricker 1975) of the fall chum salmon run in the Tanana River drainage based on the total commercial harvest, tag returns from commercial fishermen, and the number of tagged fish available to the commercial fishery was calculated at 796,963 fish (Appendix 4). The exploitation rate (Ricker 1975) based on the commercial, subsistence, and sport fisheries was 0.14 (Appendix 4).

The recovery of tagged chum salmon in the upper Tanana and Kantishna-Toklat drainages indicated a difference in bank orientation between the two stocks in the lower Tanana River. Sixty percent of the chums recovered in the upper Tanana had been tagged at the north bank fishwheel. Conversely, 64% of the chums recovered in the Kantishna-Toklat system had been tagged at the south bank fishwheel (Table 13). Although not a strong separation, it appears that chums migrating along the north bank of the lower Tanana are primarily upper Tanana River stocks, while chums migrating along the south bank are primarily Kantishna-Toklat River stocks.

Analysis of the tag returns in terms of tagging date indicates that the run timing of the upper Tanana stock is earlier than that of the Kantishna-Toklat stock. Migration of the upper Tanana stock through the two fishwheels on the lower Tanana River peaked on 25 August, while the Kantishna-Toklat run peaked 23 September (Figure 10). The validity of conclusions regarding bank orientation and run timing are questionable in light of the fact that the north and south bank fishwheels were located approximately 30 mi apart.

The ratio of tagged to untagged chums on the spawning grounds of the upper Tanana and Kantishna-Toklat drainages indicate that the stocks may not

Table 10. Age and sex composition of coho salmon sampled by fishwheel along the north bank of the Tanana River, 1979.

<u>Sex</u>	<u>Age 3<sub>2</sub></u>		<u>Age 4<sub>3</sub></u>		<u>Combined Age Classes</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Male	8	10.2	35	44.9	43	55.1
Female	5	6.4	30	38.5	35	44.9
Total	13	16.6	65	83.4	78	100.0

Table 11. Chum salmon tag recoveries by gear type.

<u>Tagging Site</u>	<u>Recovery By:</u>					<u>Total</u>
	<u>Gillnet</u>	<u>Fishwheel</u>	<u>Hook &amp; Line</u>	<u>Hand Picked</u>	<u>Unknown</u>	
North Bank	158	292	1	130	20	601
South Bank	149	289	2	226	42	708
Total	307	581	3	356	62	1309



Table 12. Chum salmon tag recoveries by fishery.

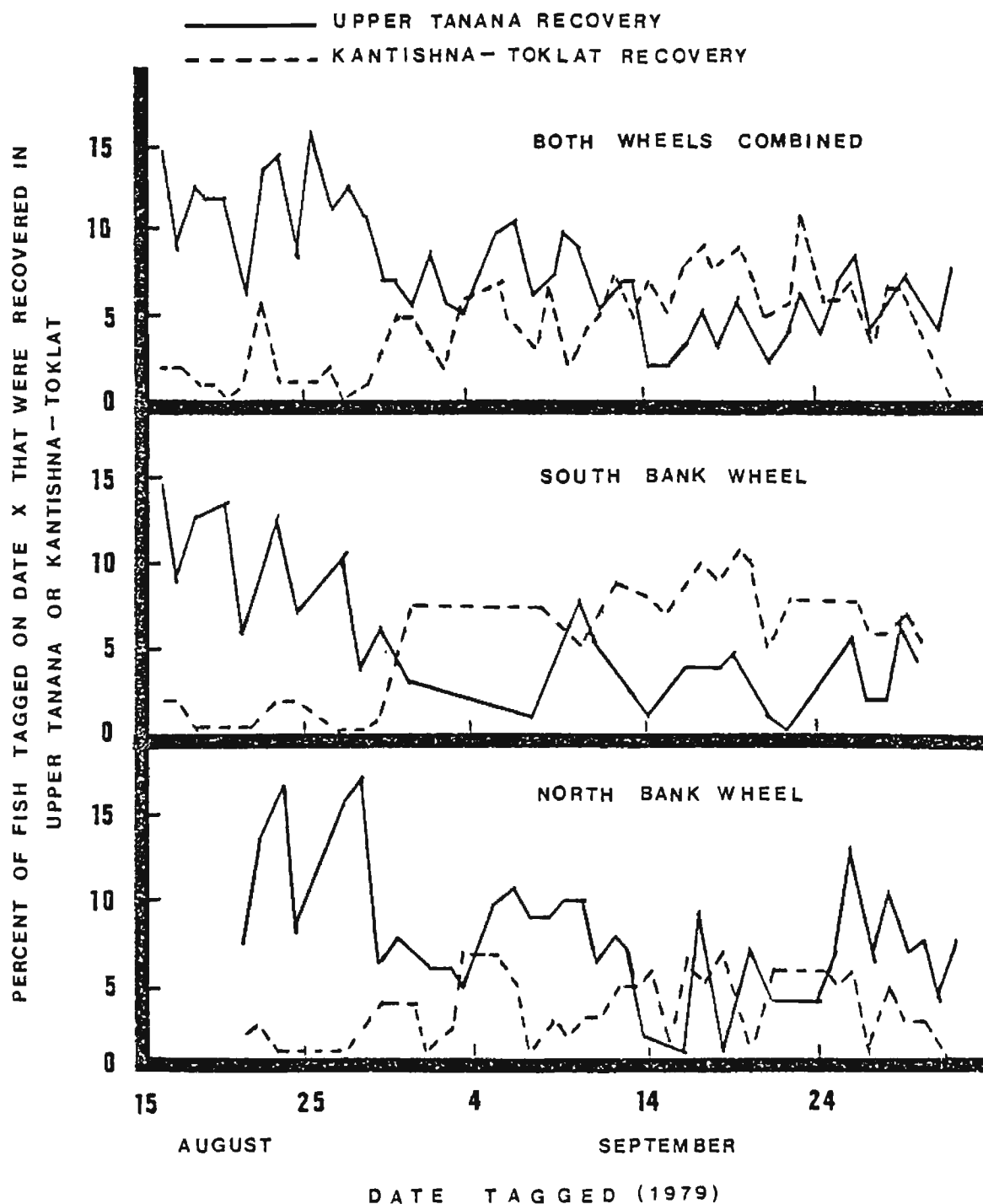
<u>Tagging Site</u>	<u>Recovery by</u>					<u>Total</u>
	<u>Commercial</u>	<u>Subsistence</u>	<u>Sport</u>	<u>Spawning Ground Survey</u>	<u>Unknown</u>	
North Bank	142	314	2	131	12	601
South Bank	109	358	2	226	13	708
Total	251	672	4	357	25	1,309

Table 13. Recovery location of chum salmon tagged at the north and south bank fishwheels on the Tanana River near Manley Hot Springs, 1979.

	Recovery Site							
	Tanana below Kantishna <sup>1</sup>		Tanana above Kantishna		Within Kantishna-Toklat System		Total	
	N	%	N	%	N	%	N	%
Total tags recovered	441	100	514	100	357	100	1,309	100
Originally tagged north bank	164	37	308	60	129	36	601	46
Originally tagged south bank	277	63	206	40	228	64	708	54

<sup>1</sup> Includes fish recovered on main Yukon River, and fish recovered on Tanana River for which specific location is unknown.

Figure 10. Migration timing of Upper Tanana and Kantishna-Toklat fall chum salmon stocks through the lower Tanana River as determined by the recovery of tagged fish. <sup>1/</sup>



<sup>1/</sup> Data is included only for days on which 50 or more fish were tagged.

have been tagged proportional to run size. Approximately 12,000 chums were checked for tags on the Toklat River spawning grounds, and 130 tagged chums were recovered, for a tagged:untagged chum ratio of 1:92. A similar number of chums were examined on the upper Tanana River spawning grounds, with only seven tagged fish recovered, for a tagged:untagged chum ratio of 1:1,714. The difference in tag frequencies between the upper Tanana and Kantishna-Toklat stocks may be the result of:

- 1) Upper Tanana stocks migrate through the tagging site near the center of the channel, thus avoiding capture by the fishwheels; or
- 2) Tagged chums bound for upper Tanana spawning grounds were intercepted by fishermen at a greater rate than untagged fish due to previous handling by tagging crews. Selective capture of tagged fish would not be a significant factor for the Kantishna-Toklat stock, since only a few fishermen operate on the Kantishna River, while the intensive fisheries are located on the upper Tanana.

The majority of the chums sampled at the north bank fishwheel, south bank fishwheel, and Toklat River spawning grounds were age 4<sub>1</sub> (Table 14). Second in occurrence was age 3<sub>1</sub>, and only a few age 5<sub>1</sub> chums were found.

### Conclusions

The 1979 Tanana River fall chum salmon run was estimated at 796,963 chums, with an exploitation rate of 0.14. The reported subsistence harvest of 51,766 chums is questionable, and was more likely closer to 92,000 chums as estimated by tag recoveries. The majority of the fish were age 4<sub>1</sub>.

The recovery of tagged fish indicates that upper Tanana River stocks tend to migrate along the north bank of the lower Tanana, while Kantishna-Toklat stocks migrate later, and along the south bank. Further study is required to resolve separation of the stocks by bank orientation and run timing.

Table 14. Age and sex composition of chum salmon sampled by fishwheel along the north and south bank of the Tanana River, and of chum salmon sampled on the spawning grounds of the Toklat River, 1979.

North Bank Wheel

<u>Sex</u>	<u>Age 3<sub>1</sub></u>		<u>Age 4<sub>1</sub></u>		<u>Age 5<sub>1</sub></u>		<u>Combined age classes</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Male	32	12.0	104	38.9	1	0.4	137	51.3
Female	37	13.8	92	34.5	1	0.4	130	48.7
Total	69	25.8	196	73.4	2	0.8	267	100.0

South Bank Wheel

<u>Sex</u>	<u>Age 3<sub>1</sub></u>		<u>Age 4<sub>1</sub></u>		<u>Age 5<sub>1</sub></u>		<u>Combined age classes</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Male	36	13.3	70	25.8	8	3.0	114	42.1
Female	55	20.3	97	35.8	5	1.8	157	57.9
Total	91	33.6	167	61.6	13	4.8	271	100.0

Spawning Grounds

<u>Sex</u>	<u>Age 3<sub>1</sub></u>		<u>Age 4<sub>1</sub></u>		<u>Age 5<sub>1</sub></u>		<u>Combined age classes</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Male	53	28.7	68	36.7	2	1.1	123	66.5
Female	25	13.5	37	20.0	0	0.0	62	33.5
Total	78	42.2	105	56.7	2	1.1	185	100.0

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## APPENDICES

Appendix 1. Anvik River king salmon escapement distribution as indicated by survey, 1975-1979.

River Area	1975		1976		1977		1978		1979		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Lower Anvik <u>1/</u>	82	12.8	103	8.9	54	4.0	168	12.7	90	6.1	497	8.0
Beaver Cr. <u>2/</u>	10	1.6	0	0	15	1.1	-	-	8	0.5	33	1.0
Yellow River <u>3/</u>	-	-	93	8.1	32	2.3	68	5.1	139	9.4	332	6.0
Upper Anvik <u>4/</u>	548	85.6	958	83.0	1,261	92.6	1,088	82.2	1,247	84.0	5,102	86.0
Total	640	100.0	1,154	100.0	1,362	100.0	1,324	100.0	1,484	100.0	5,964	100.0

1/ Lower Anvik surveyed by boat from weir site to Beaver Creek. Aerial and boat surveys have shown few spawning king salmon below Beaver Creek.

2/ Aerial survey.

3/ Aerial survey. Counts may not be accurate due to water turbidity.

4/ Tower count.



Appendix 2. Number of chum salmon captured by fishwheel and date of capture, Tanana River, 1979.

Date	North Bank		Date	South Bank	
	N	Cumulative		N	Cumulative
8/15	0	0	8/15	49	49
8/16	0	0	8/16	52	101
8/17	9	9	8/17	68	169
8/18	20	29	8/18	81	250
8/19	49	78	8/19	80	330
8/20	36	114	8/20	132	462
8/21	71 <sup>2/</sup>	188	8/21	91	553
8/22	80	268	8/22	69	622
8/23	137	405	8/23	95	717
8/24	98 <sup>2/</sup>	503	8/24	90	807
8/25	35 <sup>2/</sup>	538	8/25	61	868
8/26	45	583	8/26	56	924
8/27	88	671	8/27	139	1,063
8/28	102	773	8/28	67	1,130
8/29	155	928	8/29	171	1,301
8/30	267 <sup>2/</sup>	1,195	8/30	202	1,503
8/31	400	1,595	8/31	153	1,656
9/1	173	1,768	9/1	74	1,930
9/2	134	1,902	9/2	20	1,750
9/3	107	2,009	9/3	3 <sup>2/</sup>	1,753
9/4	96	2,105	9/4	0 <sup>1/</sup>	1,753
9/5	135	2,240	9/5	0 <sup>1/</sup>	1,753
9/6	309	2,544	9/6	0 <sup>1/</sup>	1,753
9/7	583	3,132	9/7	85	1,838
9/8	614	3,746	9/8	55 <sup>3/</sup>	1,893
9/9	857	4,603	9/9	16	1,909
9/10	802 <sup>2/</sup>	5,405	9/10	116	2,025
9/11	592	5,997	9/11	191	2,216
9/12	425 <sup>2/</sup>	6,422	9/12	124	2,340
9/13	155 <sup>2/</sup>	6,877	9/13	42	2,382
9/14	319 <sup>2/</sup>	7,196	9/14	86	2,472
9/15	259	7,455	9/15	146	2,618
9/16	397	7,852	9/16	310	2,928
9/17	428	8,280	9/17	405	3,333
9/18	490	8,770	9/18	256	3,589
9/19	137 <sup>2/</sup>	8,907	9/19	177	3,766
9/20	269	9,176	9/20	117	3,883
9/21	116 <sup>2/</sup>	9,292	9/21	77	3,960
9/22	166 <sup>2/</sup>	9,459	9/22	89	4,049
9/23	145 <sup>2/</sup>	9,603	9/23	79	4,128
9/24	129	9,732	9/24	0 <sup>1/</sup>	4,128
9/25	146	9,878	9/25	27	4,155
9/26	170	10,048	9/26	173	4,328
9/27	109	10,157	9/27	121	4,449
9/28	97	10,254	9/28	131	4,580
9/29	68	10,322	9/29	103	4,683
9/30	86	10,409	9/30	103	4,786 <sup>3/</sup>
10/1	113	10,521			
10/2	61	10,592			
10/3	50	10,632 <sup>3/</sup>			

<sup>1/</sup> Wheel not fishing.

<sup>2/</sup> Wheel fished partial day.

<sup>3/</sup> North bankwheel fished during total 48 days, 12 of these were partial averaging approximately 12 hours, total time fished for salmon approximately 1,008 hours out of possible 1,152 hours for a rate of 253 chum/day.

South bankwheel fished during a total of 43 days a total of approximately 1,008 hours for a rate of 114 chum/day.

Appendix 3. Number of chum salmon tagged by fishwheel and date of capture, Tanana River, 1979.

Date	North Bank		Date	South Bank	
	N	Cumulative		N	Cumulative
8/15	0	0	8/15	49	49
8/16	0	0	8/16	52	101
8/17	7	7	8/17	58	159
8/18	19	26	8/18	76	235
8/19	43	69	8/19	47	282
8/20	49	118	8/20	51	333
8/21	58	176	8/21	85	418
8/22	69	245	8/22	48	466
8/23	107	352	8/23	63	529
8/24	87	439	8/24	67	596
8/25	32	471	8/25	48	644
8/26	45	516	8/26	36	680
8/27	83	599	8/27	82	762
8/28	55	654	8/28	67	829
8/29	77	731	8/29	81	910
8/30	98	829	8/30	47	957
8/31	141	970	8/31	62	1,019
9/1	71	1,041	9/1	47	1,066
9/2	67	1,108	9/2	18	1,084
9/3	60	1,168	9/3	3	1,087
9/4	49	1,217	9/4	0	1,087
9/5	100	1,317	9/5	0	1,087
9/6	147	1,464	9/6	0	1,087
9/7	129	1,593	9/7	78	1,165
9/8	115	1,708	9/8	35	1,200
9/9	115	1,823	9/9	11	1,211
9/10	113	1,936	9/10	92	1,303
9/11	123	2,059	9/11	100	1,403
9/12	186	2,245	9/12	116	1,519
9/13	147	2,392	9/13	36	1,555
9/14	103	2,495	9/14	86	1,641
9/15	78	2,573	9/15	130	1,771
9/16	87	2,660	9/16	277	2,048
9/17	84	2,744	9/17	341	2,389
9/18	76	2,820	9/18	223	2,612
9/19	49	2,869	9/19	100	2,712
9/20	50	2,919	9/20	117	2,829
9/21	50	2,969	9/21	78	2,907
9/22	46	3,015	9/22	60	2,967
9/23	46	3,061	9/23	39	3,006
9/24	50	3,111	9/24	0	3,006
9/25	59	3,170	9/25	25	3,031
9/26	50	3,220	9/26	100	3,131
9/27	79	3,299	9/27	100	3,231
9/28	80	3,379	9/28	100	3,331
9/29	59	3,438	9/29	98	3,429
9/30	76	3,514	9/30	102	3,531
10/1	104	3,618			
10/2	61	3,679			
10/3	49	3,728			

Appendix 4. Population estimate of fall chum salmon in the Tanana River drainage, 1979.

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	<u>Number</u>
Commercial catch (C)	34,300
Commercial fishery tag returns (R)	251
Tagged fish available to commercial fishery (M) <u>1/</u>	5,832
Population estimate (N) <u>2/</u>	796,963
Exploitation Rate <u>3/</u>	0.14

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1/ Calculated as total number of fish tagged (7,259) minus an estimated 10% tag loss (726), minus the sport and subsistence tag returns (676) minus the number of tags returned from unknown sources (25).

2/ Petersen estimate  $N = \frac{(M)(C)}{(R)}$

3/ Exploitation Rate =  $R/M$

Where R is the tag return from commercial (251), subsistence (672) and sport (4) fisheries; and M is the number of tagged fish available to these fisheries, calculated as the total number of fish tagged (7,259) minus an estimated 10% tag loss (726).

